SSG-WI 2005 Transmission Planning Program
2015 Reference Case

Key Assumptions

Load Forecast

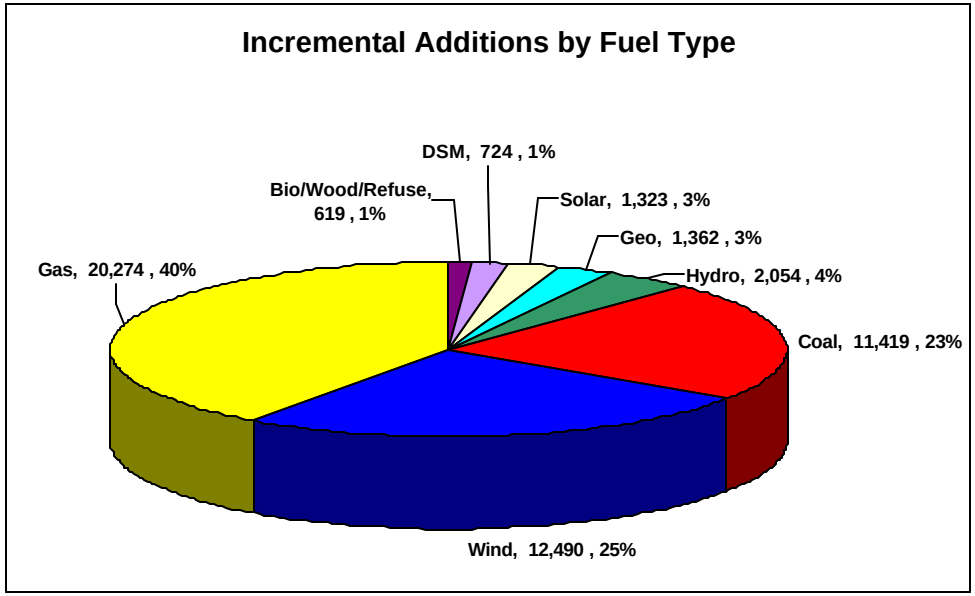
- The WECC's 2005 L&R load forecast is used for the 2015 studies, with three large exceptions:
  (1) For the NW States, the Council's GENESYS/HELM models are used. The models rely on historical load shapes for the Northwest and a historic relationship between load and temperature for each month. The net result is hourly demand for 2015 given 2003 temperatures (2003 is considered medium water year)
  (2) For the Rocky Mountain states the load forecast in the RMATS study (Sep 2004) is used, escalated from 2008 to 2015 using values approved by regional representatives
  (3) For California, the latest CEC load forecast is used (Sept, 2005)
- The topology adopted for this planning process is more detailed in some sub-regions than the WECC topology: two bubbles instead of one for NW, and multiple additional bubbles for Rocky Mountain States and California. The load forecast is disaggregated for the SSG-WI topology to create monthly peak and energy loads for each SSG-WI topology bubble. These monthly peak and energy load amounts are then distributed to the bus bars using the WECC power flow case. Before this distribution, generation station service is removed from the load forecast to avoid double counting. Also, the power flow case is modified to capture incremental transmission additions expected to occur by 2015
- The monthly peak and energy loads are converted to hourly shapes developed using FERC Form 714. Hourly load shapes are an important factor in modeling transmission congestion. Load shapes are determined for each bubble (all buses within a bubble use the same hourly shape). With two exceptions, hourly shapes for each bubble are "normalized" using 2002 actual loads as the sample year.
  Exceptions:
  (1) hourly shapes developed in RMATS are used for the Rocky Mountain States;
  (2) hourly shapes produced by the Council/BPA's HELMS model are used for the NW states.
- For 2008 Base Case CAISO adjusted loads and mapping to buses to capture the unique characteristics of pumping plants in California. This has not been done for 2015 Reference Case.
- Transmission losses in the load forecast are grossed up to generation output. Currently, WECC does not collect loss amounts.
- Existing and some forecasted DSM is embedded in the load forecast, but currently these amounts are not collected by WECC. New DSM programs are modeled as dispatchable resources in 2015 studies. Interruptible loads are not modeled
- No load forecast sensitivity is run for the 2015 base case

As modeled in GridView for 2015 Base Case
2015

AREA	ANNUAL ENERGY MWh	Annual Peak MW
IMPERIAL	4,212,776	1,091
LADWP	33,314,726	6,249
MEXICO-C	15,278,260	3,209
PG&E_BAY	51,987,840	10,919
PG&E_VLY	79,993,555	19,549
SANDIEGO	22,962,706	5,058
SOCALIF	134,936,173	25,462
ARIZONA	104,761,526	22,626
NEVADA	29,345,006	7,276
NEW MEXI	27,245,822	4,730
WAPA L.C	1,590,561	252
ALBERTA	77,291,069	10,794
B.C.HYDR	74,158,753	12,457
NW_EAST	74,310,368	12,355
NW_WEST	107,629,066	17,913
B HILL	6,588,272	976
BHB	3,695,185	506
BONZ	1,242,519	237
COL E	62,135,625	10,727
COL W	6,440,916	993
IDAHO	18,631,181	3,694
IPP	-	1
JB	-	1
KGB	6,826,263	1,429
LRS	3,996,419	581
MONTANA	10,807,468	1,698
SIERRA	11,728,413	1,995
SW WYO	4,553,805	637
UT N	42,173,311	7,999
UT S	6,057,463	1,189
WYO	2,454,859	356
YLW TL	-	1
Total	1,026,349,907	192,959

SSG-WI 2005 Transmission Planning Program
2015 Reference Case

Network Representation and Topology	• WECC's 2004 summer–heavy power flow case (HS2A PF) is used for all months of the 2008 test year. This **c**ase is rerun to account for updates to transmission representation in CA, CO, NW, AZ, ID, WY, and UT. Specifically, the 2015 reference case modifies the 2008 base case to include the following major additions: - Palo Verde – Devers #2 - Tehachapi Wind transmission – 2 lines - Navajo/ Desert Rock; Four Corners – Moenkopi - North Phoenix (Raceway) - Pinal Project - Amps Phase Shifter (Mill Creek Phase Shifter) • Criteria for line additions in the 2015 reference case: Use conservative transmission assumptions in the base cases, with minimal additions; add only committed projects. Purpose of reference case is to expose transmission problems. • The power flow case takes into account differences in time zones • Topology: the WECC 22-bubble is used, with these exceptions: - The single NW bubble is split into west and east NW bubbles - The single PG&E bubble is split into three bubbles, to accommodate variations in load types and shapes - The RMATS topology is used for the Rocky Mountain states, except that the Montana bubbles are reduced from 2 to 1 With these changes, the SSG-Wi topology includes a total of 33 bubbles ***See Attachment 1***
Transmission Path Ratings & Nomograms	• The Transmission Subgroup started with the WECC path rating catalog, and applied modifications to capture operating limits for a number of paths • Derates to recognize historical OTC limitations are applied • Nomograms take seasonal derates into consideration ***See Attachment 2 and 3***
Transmission Forced Outages	Grid View's ability to model transmission forced outages is not used in this study. Reason: transmission maintenance outages typically occur during off peak usage only (low impact) and forced transmission outages occur infrequently
Wheeling rates	Wheeling rates are not included in the 2015 study. 2008 studies included sensitivities with wheeling rates on the inter-area basis. The results were debated and it was decided to exclude the wheeling rates from 2015 studies. Reason: lack of sufficient data just include non-firm wheeling rate; most firm transactions include wheeling as a sunk cost. This is an area that requires improvement.

Generating Resources	Resource information is collected at the unit level of detail Existing resources • Existing resources were identified through the WECC power flow case and the SSG-WI 2003, CEC, RMATS, and other data bases. The states reviewed the list of resources and capacities, and their comments are included to the extent possible. Incremental resources • Incremental resources are resources expected to be placed in service between 2008 and the 2015 (inclusive) • Generation subgroup collected data from utilities' IRPs and coordinated with state representatives, NTAC and NWPCC. RPS requirements and NREL's recommended wind generation additions are also considered 
Thermal Unit Operational Info	Thermal unit commitment • Thermal unit commitment is modeled in the study • Data requirements for unit commitment include capacity information, planned and forced outage assumptions, heat rate curves, ramp rates, minimu m up/down times, start-up costs, non-fuel variable O & M costs (Emission rates/constraints and must-run status are capabilities in GridView but are not modeled at this time). • The NWPCC's database supporting the Council's Fifth Power Plan, CEC information, Platts database, and other sources are used to develop generic assumptions for various thermal technologies and locations. Thermal units are broken into 26 categories on the basis of fuel type, technology type, vintage, and capacities. A set of assumptions is developed for each unit category, with mo re detailed data needed on gas-fired units. Most incremental resources added in the 2015 case fit into one of the existing 26 categories. A few resources did not fit the existing categories, but are assigned to them due to lack of better data. Other thermal unit data • Thermal unit capacities are based on the power flow case. Thermal unit capacities are net of station service and/or on-site direct use of electricity. The power flow capacities are compared to CEC, Platts, and other data sources and the majority of differences are minimal wh ere material difference are noted by experts, capacities are edited. • As a starting point, these data elements are drawn from assumptions used in RMATS. They are then modified by State Energy Office, Planning Council, and other SSG-Wi participants and experts ***See Attachment 4 and 5***

Thermal forced and scheduled outages

- For forced and planned maintenance outages, the rates used are by fuel type and technology type from the data base supporting EIA's energy Outlook 2005 are used
- Forced outages are modeled probabilistically using GridView's Monte Carlo capability. The approach used will be repeated between the cases

	Outages	
	Forced (%)	Planned (%)
Existing Coal	6.6	7.1
New Coal Plant	6.0	6.5
Oil/Gas Steam	7.1	10.5
Combustion Turbine	3.6	4.1
Combined Cycle	5.5	4.1
Existing Nuclear	7.0	7.5
Advanced Nuclear	3.8	6.1

Thermal start-up costs; minimum up/down time; ramp-rates

- Start-Up costs re based on IRP and expert input, and includes fuel, O&M and other costs to reach point of synchronization. Minimum up and down time (hrs) provided by SSG-WI members.
- Ramp rates provided by expert survey.

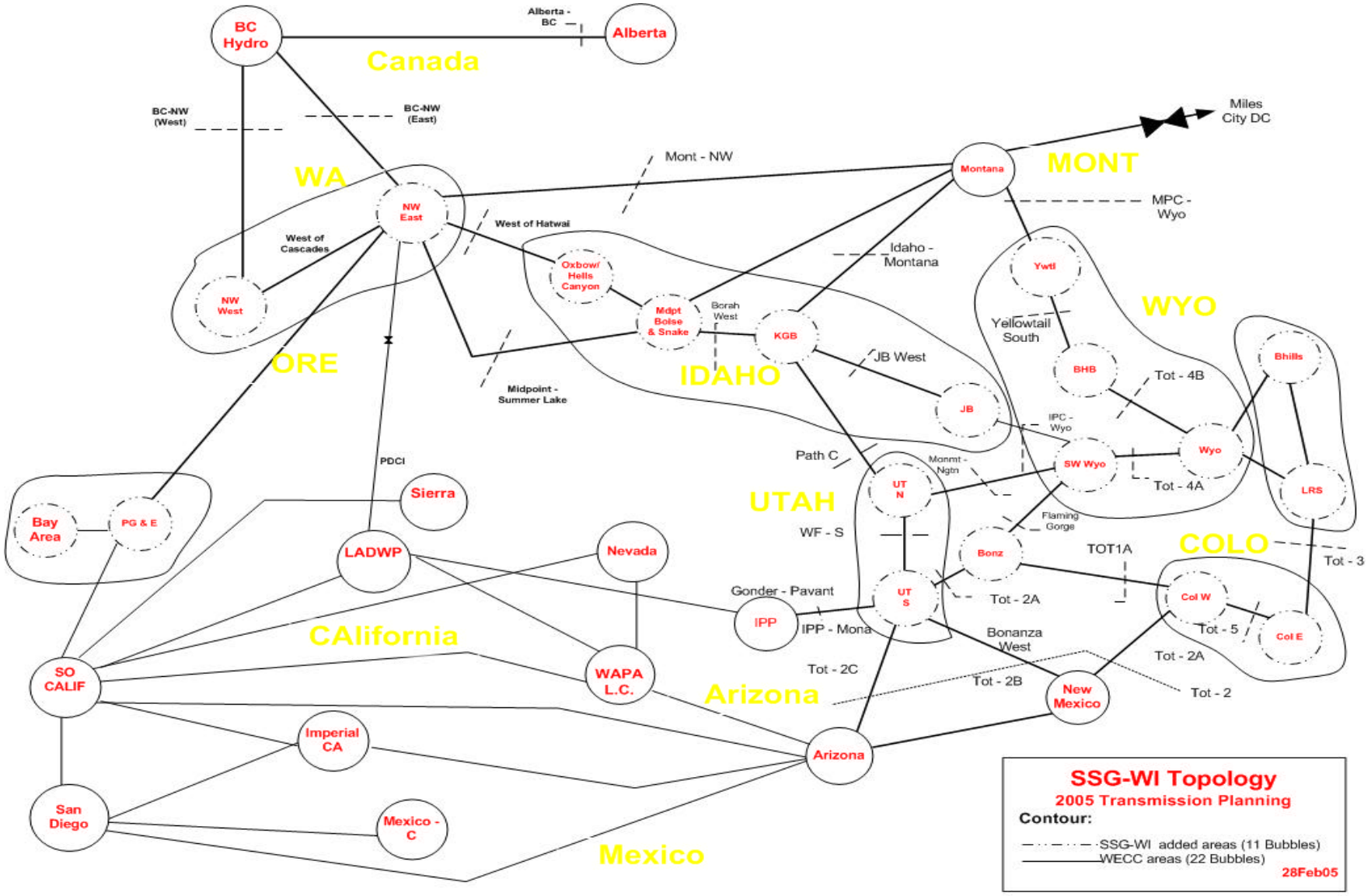
	Start-Up Costs $/Unit per Start	Min Up/Min Down Hrs
Combustion Turbine	$ 2,000	8/8
Combined Cycle	$10,000	8/8
Oil/Gas Steam	$3,100	8/8
Coal Steam	$15,000	8/8

Ramp rate	MW/Min
Combustion Turbine	1
Combined Cycle	1
Oil/Gas Steam	1
Coal Steam	2.5

Fuel Prices	Gas prices: • Several Henry Hub price sensitivities are used (2005$/MMbtu): $5, $4, and $7. $5 is the base assumption • The NW Power and Conservation Council's methodology in the Fifth Power Plan is used to estimate Western gas market hub and burner tip area differentials. • Fixed transportation cost (capacity charge) of delivering gas from regional hubs to burner tip areas is included with other fixed costs of the scenario ***See Attachment 6*** Coal prices: • Coal price forecast in EIA's "Annual Energy Outlook 2005" is used. This forecast is based on historical trends. The EIA forecast of transportation costs includes two tiers of transportation adders: - Tier 1 (based on historical trends) - Tier 2 (tier 1 plus additional transportation for high demand areas) • The tier adders are applied to each coal plant taking into account the sources of coal supplies and the demand area (generator location). The transportation adders are then added to the coal price to get the total price at each plant. The combined price is then averaged over all plants within each SSG-Wi topology bubble, and the averages are entered in GridView. ***See Attachment 7***
Hydro Generation	• Previously, SSG-Wi planned to use the Council's GENESYS model to simulate hydro generation. Data and other technical issues arose that prevent this. However, ABB is working to include this algorithm in the GridView model for the region's future use. This is an area of improvement. • These data are used: - NW federal, Mid-C Nonfederal, and PacifiCorp: recent historical hourly hydro generation that is reasonably reflective of latest Biological Opinion. Three historical years are chosen: Medium (2002), Low (2003 and High (2000). The preliminary base case run reflects the Medium hydro case only. Sensitivities will be run for the Low and High cases for the final base case - Other NW nonfederal: actual hourly data is lacking. Fallback is monthly actual data, to which peak shaving algorithm is applied - Central Valley Project: Due to difficulty of disaggregating hourly forecasted data to individual plants, CAISO historical hourly data is used - Other California: CAISO has provided hourly historical hydro data aggregated by river system - Colorado: Bureau of Reclamation--Upper and Lower Colorado Regions provided monthly forecasted data, which reflects recent severe drought in terms of updated hydrology and operational algorithms, to which GV peak shaving algorithm is applied. Still need to obtain non-Federal Hydro data - Canada: BC Hydro provided monthly hydro for adverse, average and above average hydro conditions grouped by their coastal, Peace River and Columbia River facilities. For 2008 studies, the data is shaped using year 2002 actual loads and hourly flows in and out of BC Hydro territory (BCH-US and BCH-Alberta paths), combined with treating the thermal generation as a block resource. Peak shaving algorithm is utilized for incremental hydro resources added for 2015 study. - Arizona/Desert SW: Obtain non-Federal hydro data from Salt River Project and other projects
Renewable Generation	• Hourly wind shapes applied to most wind generation are supplied by National Renewable Energy Lab (NREL). CAISO provided wind shapes for its areas based on actual data. Wind is treated as a fixed input to the model • CDEAC geothermal task force provided production profiles for all geothermal plants, except for specific plants in CA - data for which is provided by CAISO • Solar production profiles are provided by NREL

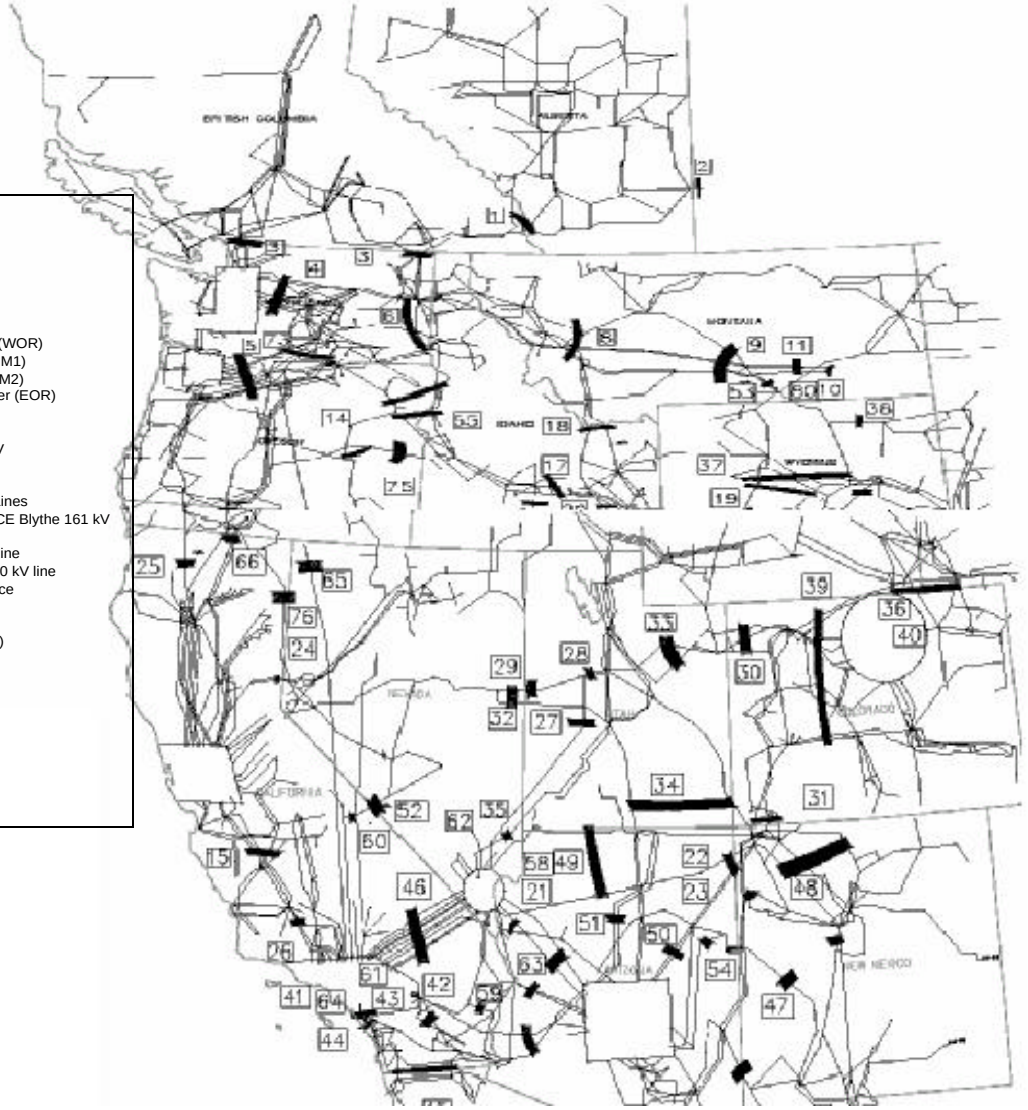
DSM	• Existing and some forecasted DSM programs are embedded in the load forecast, but currently these amounts are not collected by WECC. • New DSM programs are modeled as dispatchable resources in 2015 studies. Interruptible loads are not modeled

Attachment 1 – SSG-WI Topology



Attachment 2 – Western Interconnect Major Paths

1. Alberta-British Columbia	38. TOT 4B
2. Alberta-Saskatchewan	39. TOT 5
3. Northwest-Canada	40. TOT 7
4. West of Cascades-North	41. Sylmar to SCE
5. West of Cascades-South	42. IID-SCE
6. West of Hatwai	43. North of San Onofre
7. Intentionally Left Blank	44. South of San Onofre
8. Montana to Northwest	45. SDG&E-CFE
9. West of Broadview	46. West of Colorado River (WOR)
10. West of Colstrip	47. Southern New Mexico (NM1)
11. West of Crossover	48. Northern New Mexico (NM2)
12. Intentionally Left Blank	49. East of the Colorado River (EOR)
13. Intentionally Left Blank	50. Cholla-Pinnacle Peak
14. Idaho to Northwest	51. Southern Navajo
15. Midway-Los Banos	52. Silver Peak-Control 55 kV
16. Idaho-Sierra	54. Coronado West
17. Borah West	55. Brownlee East
18. Idaho-Montana	58. Eldorado-Mead 230 kV Lines
19. Bridger West	59. WALC Blythe 161 kV -SCE Blythe 161 kV
20. Path C	60. Inyo-Control 115 kV Tie
21. Arizona to California	61. Lugo-Victorville 500 kV Line
22. Southwest of Four Corners	62. Eldorado-McCullough 500 kV line
23. Four Corners 345/500 Qualified Path	63. Perkins-Mead-Marketplace
24. PG&E-Sierra	500 kV Line
25. PacifiCorp/PG&E 115 kV Interconnection	64. Marketplace-Adelanto
26. Northern-Southern California	65. Pacific DC Intertie (PDCI)
27. Intermountain Power Project DC Line	66. COI
28. Intermountain-Mona 345 kV	71. South of Allston
29. Intermountain-Gonder 230 kV	73. North of John Day
30. TOT 1A	75. Midpoint-Summer Lake
31. TOT 2A	76. Alturas Project
32. Pavant-Gonder 230 kV	77. Crystal-Allen
33. Bonanza West	78. TOT 2B1
35. TOT 2C	79. TOT 2B2
36. TOT 3	80. Montana Southeast
37. TOT 4A	



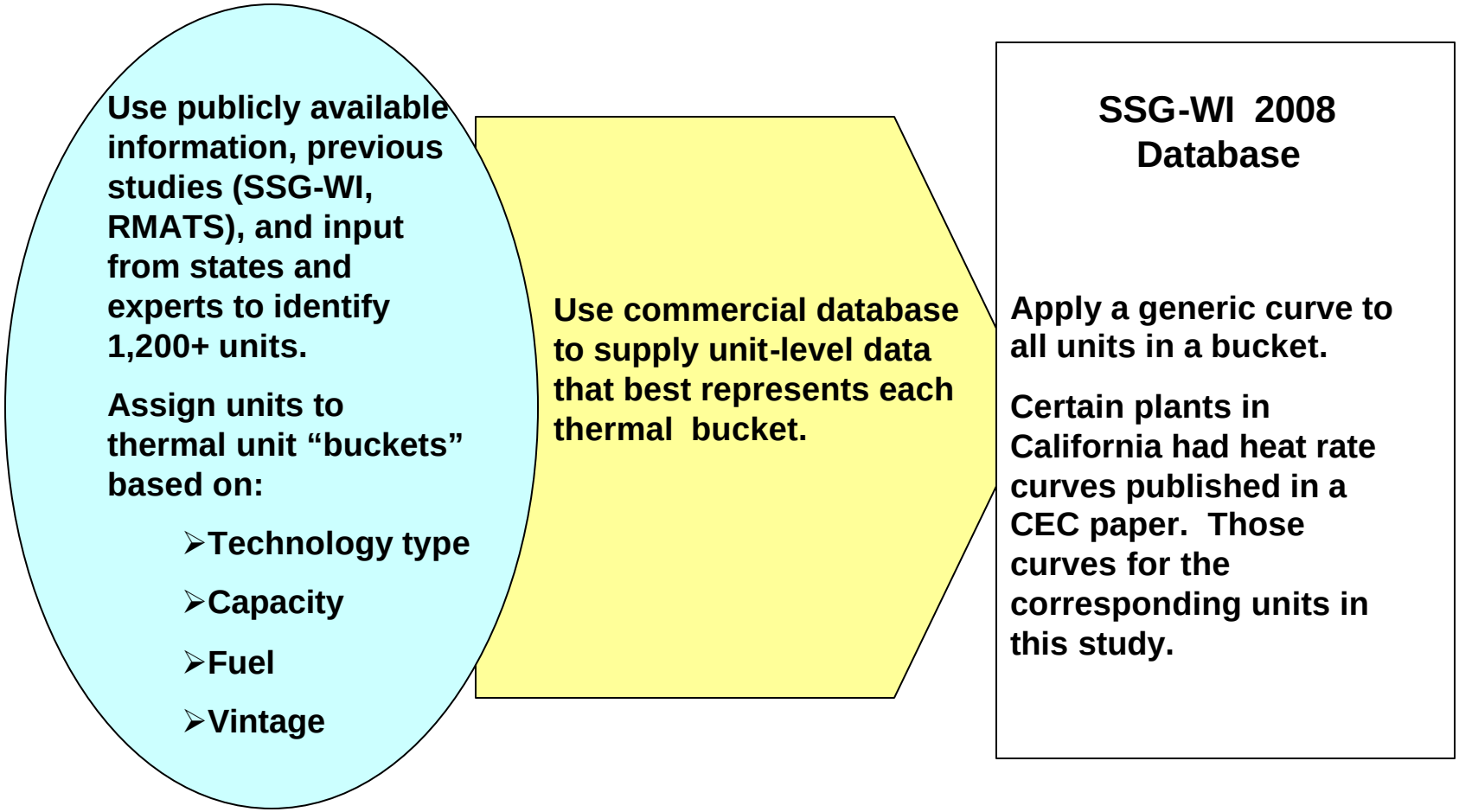
Attachment 3 – WECC Path Catalogue Operating Limits & Other Adjustments Made by SSG –WI

Interface Name	Forward Limit (MW)	Reverse Limit (MW)
ALBERTA - BRITISH COLUMBIA	700	-720
ALBERTA - SASKATCHEWAN	150	-150
ALTURAS PROJECT	300	-300
BILLINGS - YELLOWTAIL	400	-400
BONANZA WEST	785	
BORAH WEST	2307	
BORAH WEST	2200	
BROWNLEE EAST	1850	
CHOLLA - PINNACLE PEAK	1200	
COI	4700	-3675
CORONADO - SILVER KING - KYRENE	1100	
Crystal - H Allen 500 kV PS	950	
Crystal - H Allen230 kV PS	950	
Devers Bank No. 1	1120	-1120
EAGLE MTN 230_161 KV - BLYTHE 16		-218
El Centro Bank	215	-215
EOR	8055	
FOUR CORNERS 345_500	840	-840
HA-Red Butte PS	300	-300
IDAHO - MONTANA	337	-337
IDAHO - NORTHWEST	2400	-1200
IDAHO - SIERRA	500	-360
IID - SCE	600	
INTERMOUNTAIN - GONDER 230 KV	220	
INTERMOUNTAIN - MONA 345 KV	1400	-1200
INYO - CONTROL 115 KV TIE	56	-56
IPP DC LINE	1920	-1400

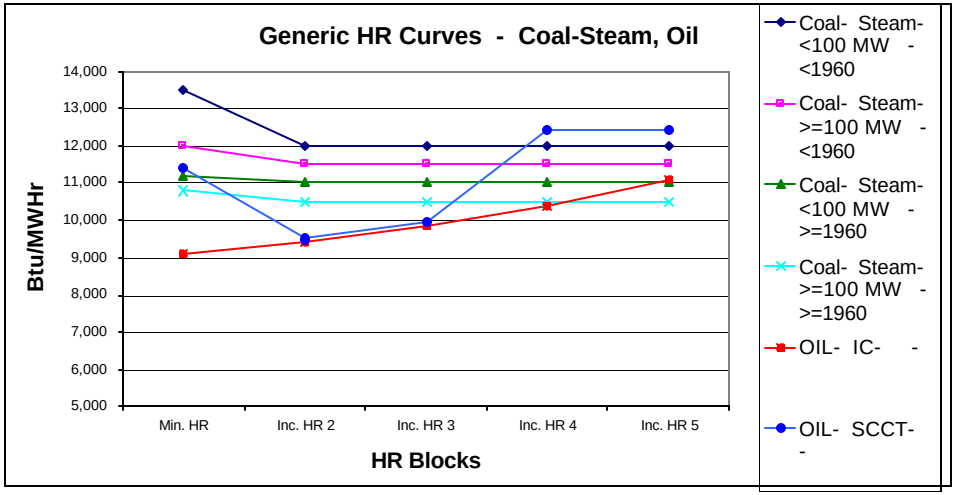
Interface Name	Forward Limit (MW)	Reverse Limit (MW)
MIDPOINT - SUMMER LAKE	1500	-600
MIDWAY - LOS BANOS	5400	
MONTANA - NORTHWEST	2200	-1350
NORTH OF JOHN DAY	8600	-8600
North of Miguel	2000	
NORTH OF SAN ONOFRE	2440	
NORTHERN NEW MEXICO (NM2)	1665	-1450
NORTHWEST - CANADA	2000	-2800
NW to Canada East BC	400	-400
PACI vs PDCI	7300	
PACIFIC DC INTERTIE (PDCI)	3000	-2100
PACIFICORP_PG&E 115 KV INTERCON.	80	-45
Path 26	3700	-3000
Path 45	408	-800
PATH C	775	-850
PAVANT INTRMTN - GONDER 230 KV	440	-235
PERKINS - MEAD - MARKETPLACE 500	1400	
PG&E - SPP	160	-150
Pinto - 4 Corners PS	600	-600
PV West	3600	
SCIT	16700	-16700
SDGE Import Limit	2850	
Shiprock - Lost Canyon PS	400	-400
Sigurd - Glen Canyon PS	300	-300
SILVER PEAK - CONTROL 55 KV	17	-17
South of Lugo	6100	-6100
South of Navajo	2264	

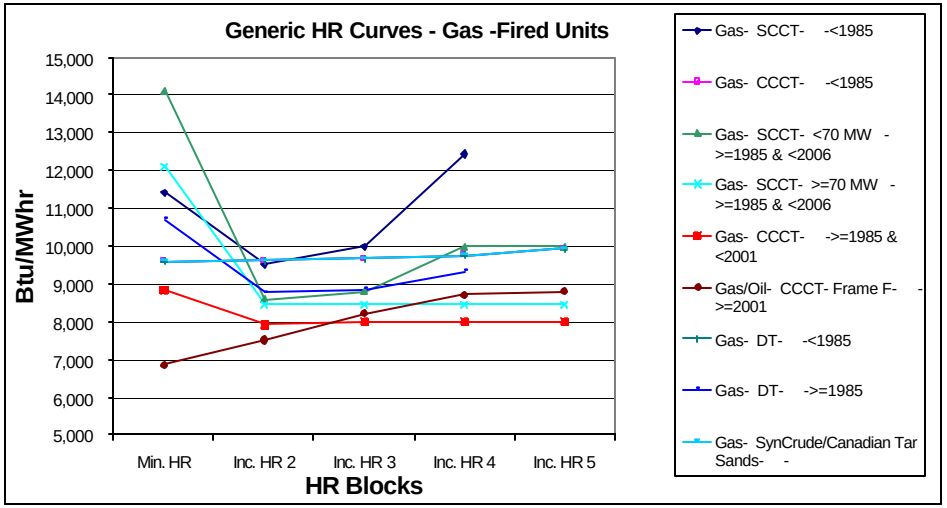
Interface Name	Forward Limit (MW)	Reverse Limit (MW)
SOUTH OF SAN ONOFRE	2500	
SOUTHERN NEW MEXICO (NM1)	1048	-1048
SOUTHWEST OF FOUR CORNERS	2325	
SYLMAR - SCE	1600	-1600
TOT 4a 4b combined	1096	
TOT 1A	650	
TOT 2A	690	
Tot 2a 2b 2c Nomogram	1570	-1600
TOT 2B	780	-850
TOT 2B1	560	-600
TOT 2B2	265	-300
TOT 2C	300	-300
TOT 3	1450	
TOT 4A	810	
TOT 4B	680	
TOT 5	1675	
TOT 7	890	
WEST OF BROADVIEW	2573	
WEST OF CASCADES - NORTH	10500	-10500
WEST OF CASCADES - SOUTH	7000	-7000
WEST OF COLSTRIP	2598	
WEST OF CROSSOVER	2598	
WEST OF HATWAI	2750	
WOR	10623	
WOR - IID230	600	-600
WOR - N.Gila	1861	
WOR -n- El Dor to Lugo	2754	
WOR -n- Mc-Vic	2592	

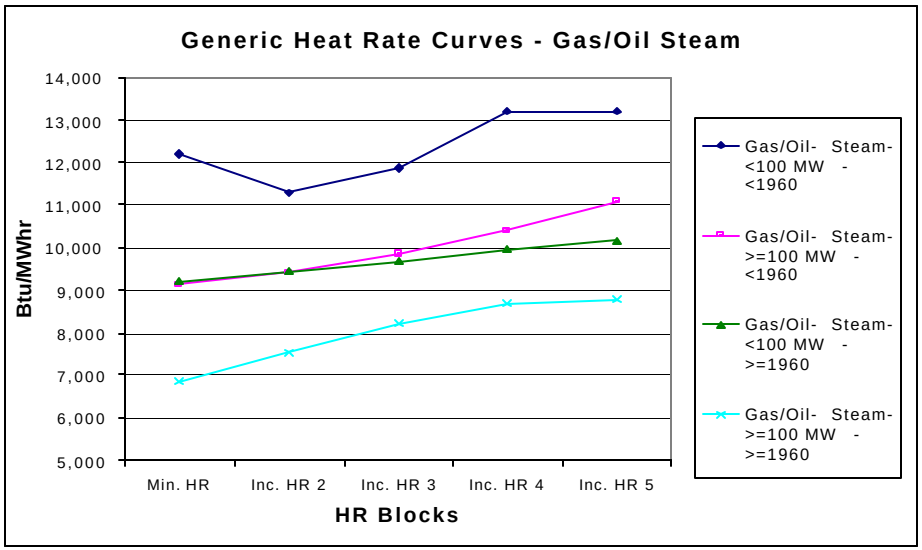
Attachment 4 – Development of Generic Assumptions (Heat Rate Curve Example)

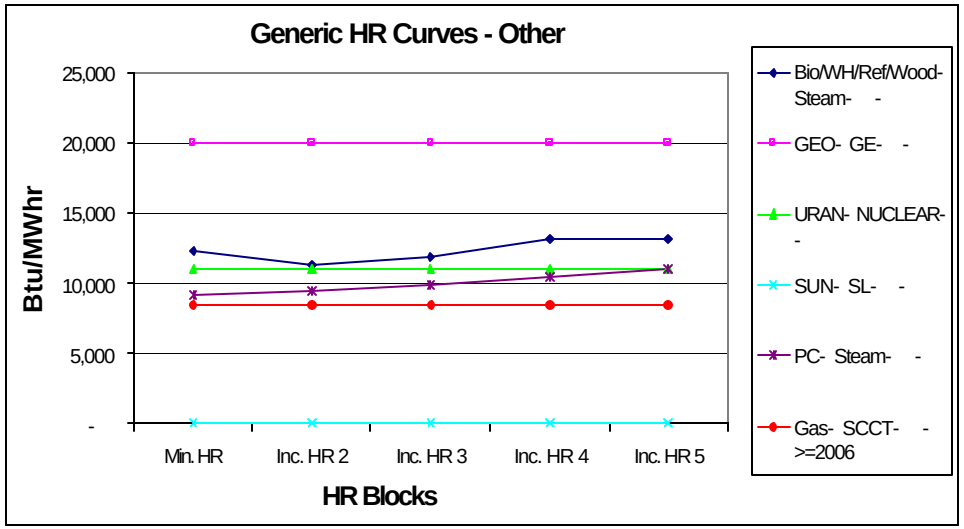


Attachment 5 – Generic Heat Rates by Fuel, Technology









Attachment 6 – Gas prices by SSG-WI Topology

Based on $5.00 2008 annual average Henry Hub
2008 gas price forecast (in 2005$/MMBtu)

Area	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
ALBERTA	$4.89	$4.88	$4.75	$4.05	$3.95	$3.97	$3.99	$4.01	$4.00	$4.01	$4.23	$4.37
ARIZONA	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
B.C.HYDRO	$5.01	$4.99	$4.86	$4.17	$4.08	$4.10	$4.12	$4.14	$4.12	$4.14	$4.36	$4.49
BAY AREA	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
BHB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
BHILLS	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
BONZ	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
COL E	$4.84	$4.83	$4.71	$4.09	$4.01	$4.03	$4.04	$4.06	$4.05	$4.06	$4.26	$4.38
COL W	$4.84	$4.83	$4.71	$4.09	$4.01	$4.03	$4.04	$4.06	$4.05	$4.06	$4.26	$4.38
IMPERIAL CA	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
IPP	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
JB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
KGB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
LADWP	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
LRS	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
MDPT BOISE & SNAKE	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
MEXICO-C	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
MONTANA	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
NEVADA	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
NEW MEXICO	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
NW EAST	$4.89	$4.88	$4.75	$4.05	$3.95	$3.97	$3.99	$4.01	$4.00	$4.01	$4.23	$4.37
NW WEST	$5.01	$4.99	$4.86	$4.17	$4.08	$4.10	$4.12	$4.14	$4.12	$4.14	$4.36	$4.49
OXBOW/HELLS CANYON	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
PG AND E	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
SAN DIEGO	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
SIERRA	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
SO CALIF	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
SW WYO	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
UT N	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
UT S	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
WAPA L.C.	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
WYO	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
YWTL	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36

Attachment 7 – Coal Price by SSG-WI Topology and Other Fuel Price Assumptions

SSG-WI Topology Bubble	**2008 Coal Price** Includes Transportation adder in 2008$/MMBtu, assuming 2.5% yearly inflation rate
ARIZONA	1.49
Big Horn Basin (BHB)	0.44
Colorado East (COL E)	0.97
Colorado West (COL W)	1.10
IPP	1.18
Jim Bridger (JB)	1.06
MONTANA	0.62
NEVADA	1.18
NEW MEXICO	1.47
Northwest West (NW WEST)	1.52
Utah North (UT N)	1.12
Wyoming (WYO)	0.53

FUEL	$/MMBtu (RMATS Study)
Biomass*	$2.22
Oil-L, Petroleum Coke	$6.62
Oil-H	$4.42
Geothermal, Waste Heat*	$1.105
Refuse*	$4.41
Uranium	$0.60